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REUSE OF SPENT COOLANTS, SOLVENTS AND CLEANING SOLUTION AT MUELLER CANADA

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FINAL REPORT

INDUSTRIAL WASTE DIVERSION PROGRAM

MUELLER CANADA

Milton, Ontario

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Date: September 6, 1994

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1.0 ABSTRACT

This report has been prepared by Mueller Canada to describe actions taken by the company to recycle generated waste, recover and reuse clean chemicals and, therefore, reduce usage and disposal of hazardous material.

The project has covered three types of hazardous waste: coolants, solvents and contaminated water. In all of these areas we have achieved good results.

Usage of replacement chemicals has been reduced by 40 to 90%, with reduction of generated waste by up to 90%.

The following chapters describe all the phases of the project.

2.0 INTRODUCTION

Mueller Canada is a manufacturer of fire hydrants and water and gas valves. Some of our manufacturing processes use the following chemicals, creating hazardous waste:

a) liquid coolants -- for lubricating and cooling of cutting tools during machining of components.

b) paint thinner -- for cleaning off paint lines and spray equipment.

C) varsol -- for cleaning parts prior to the machining.

d) perchloroethylene -- for removing the grease off the parts after disassembling.

Eventually these chemicals get contaminated and require disposal and replacement.

Additional waste is generated from the parts washing machine as some parts are washed prior to assembly. After a period of time the cleaning solution gets contaminated, requiring disposal.

In the spring of 1993, after evaluating costs associated with the purchasing of the replacement chemicals and disposing of the waste, the company decided to start a project. This project was to study the feasibility of a waste recycling program, thus reducing the amount of hazardous materials purchased and waste generated.

In April 1993, we submitted an application to the Ontario Ministry of Environment and Energy for a grant under the "Industrial Waste Diversion Program". After reviewing our proposal, the application was approved in August 1993, and the grant was provided to assist us in purchasing the equipment required for the project.

3.0 THE PROJECT

As recycling of waste chemicals required different processes, we divided the project into three subprojects, with each of them addressed independently.

3.1 Recycling of Used Coolants

Coolants are required for the machining of steel and brass components to achieve high productivity and product quality and to reduce tool cost by increasing tool life. Coolant is pumped from a sump onto the parts during the machining, then the coolant returns by gravity flow to the sump.

Mueller Canada uses two types of water soluble coolants: Trim Microsol 150 and Syntilo 9954, prepared by mixing coolant--concentrate with water in 1:20 proportion.

During the machining, the coolant gets contaminated with oil, grease,, chips, etc. In addition, bacterial growth occurs destroying cooling and lubricating characteristics of the coolant, resulting in high tooling costs, quality problems and reduced productivity. When the coolant is degraded it must be disposed of and replaced.

Prior to the start of the project we purchased approximately 4,500 litres per year of concentrated coolant and generated approximately 7,600 litres yearly of waste coolant bound for disposal.

After looking into reducing the usage of coolant-concentrate and waste generation, we decided to introduce a coolant cleaning/recycling procedure which involved cleaning out the machine sumps and filtering the used coolants. To accomplish that we purchased a portable Sump Pump and portable Tramp Oil Separator.

The Sump Pump (with dual compartments of 150 litres each, by Master Chemical Corporation) is used for:

- removing the coolant, sludge and chips from the sump
- filtering the sludge and chips from the coolant
- transporting the coolant back to the sump and to the recycling station (in our case, to the Tramp Oil Separator).

The Tramp Oil Separator (with 8 lpm capacity, by Porter Systems) has a floating skimmer which is placed in the coolant, contaminated with oil. When the pump is started, the fluid is delivered to the separator (with coalescing media) where the tramp oil is separated

and flows out into a waste drum, while the clean coolant is discharged back into a reservoir where it is recharged with a small amount of fresh coolant and stored for future reuse.

The machine sumps are cleaned on a weekly basis but tramp oil removal is done continuously, by moving the portable unit from machine to machine as required, without interrupting the machine cycle.

After implementation of the coolant recovery program, the usage of concentrated coolants has been reduced by 40% to approximately 2,800 litres per year. Generated waste has been reduced by 80% to approximately 1,500 litres per year. Additional benefit -- 5% reduction in affected tool wear and tool change costs.

3.2 Recycling of Contaminated Water

Small valve components are washed prior to assembly in the "Proceco" washing machine to remove sand, grease, etc., applied during the previous lapping operation.

Every three to six weeks (depending on a work load) approximately 1,100 litres of contaminated waste water is removed from the washing machine and collected in the underground storage tank for future disposal.

To reduce waste water generation and the amount of fresh water required for the operation, we decided to process contaminated water through a lapping process solution recycler -- Ultrafiltration Unit "Splitter Jr." (by Infinitex).

Waste water is drawn from the holding tank into a pickup tube and pump-fed under pressure to the membrane. Here the clean water, mixed with detergent, is separated from the waste water which recirculates to the waste tank, while the clean water and detergent is collected for future reuse in the original process.

Although we allowed for the contaminated water to cool down to 100 - 120°C (process requirements) and for the solid particles to settle on the bottom of the holding tank, during the recycling process the contaminated water was agitated and solid particles were clogging the unit's membrane. In addition, by returning the waste water back to the holding tank we were increasing the concentration of the contaminants, thus worsening the performance of the unit.

To improve the performance of the unit we installed a fluid equalizing system consisting of the holding tank (for water to cool down and solids to settle on the bottom) and a process tank. Both tanks were connected with a hose for water to transfer from the

holding tank to the process tank. The Ultrafiltration unit now recycles water from the process tank without agitating contaminated water in the holding tank.

After each cycle (usually 24 hours), the process tank is cleaned, the unit back-flushed and a new cycle would start. Recovered clean water, mixed with detergent, is reused for the washing operation.

Prior to the start of the project, we generated approximately 15,000 litres of waste water per year. With the recycling program,, generated waste water has been reduced by 80% to approximately 3,000 litres per year. The usage of fresh water has been decreased by 11,400 litres per year. Additional benefit -- reduction in usage of detergent.

3.3 Recycling of Waste Solvents

The three solvents most used by Mueller Canada are: perchloro-ethylene, paint thinner and varsol. Used in different manufacturing processes, these solvents get contaminated and require replacement. Waste solvents are disposed through approved methods.

To reduce the cost of replacement solvents and waste disposal, we decided to look into the possibility of recycling the waste solvents, recovering clean solvents and reusing them in manufacturing processes. Therefore, disposing only sludge left over from the recycling.

After evaluating installation, operation, safety and maintenance requirements, we purchased a vacuum assisted "Chemmaster" Solvent Distillation Unit, Model #00015V, equipped with 1,100 litre closed loop cooling water system (by Chemical Management Technology Inc.)

After the unit's chamber is filled with dirty solvent and a lid is closed, the solvent is heated to its boiling point. The pure solvent vapours pass to the condenser where the vapours are cooled and condensed to a liquid form. The recovered solvents are reused and residual contaminants, remaining in the chamber, are disposed.

To improve the safety of the recycling process, an exhaust fan has been installed over the unit and protective shields have been introduced to prevent direct light exposure.

3.3.1 Recycling of Perchloroethylene

Some assembled parts are rejected during testing. To determine the cause of failure the parts are taken apart and the grease is

washed off of the components in the vapour degreasing machine using perchloroethylene. Contaminated perchloroethylene was then disposed.

Prior to the implementation of the project, we purchased approximately 8,300 litres of perchloroethylene per year and generated the same amount of waste.

Using the Solvent Distillation System, we have been able to recover 90% of clean solvent for further use in manufacturing. Waste generation has also been reduced by 90% to 120 litres per year.

We did not incur any problems during recycling and did not require any special preparation.

3.3.2 Recycling of Paint Thinner

When paint line hoses are clogged with dry paint, or when we change the colour of applied paint, the hoses and spray equipment are cleaned using paint thinner. Contaminated paint thinner is then disposed.

Prior to the implementation of the project, the yearly usage of the thinner was 10,000 litres, with a similar amount of waste generation.

At the beginning, the recycling of contaminated paint thinner gave us good results, but we ran into the problem of removing sludge paint out of the unit after recycling. The sludge would stick to the bottom of the chamber, requiring an operator to do manual scraping in a bending position and wearing a respirator. This was not acceptable.

We tried to use plastic liner bags, ie: to insert a bag into the chamber and to fill the bag with waste paint thinner. After the recycling process, the bag (with left over sludge in it) was removed from the unit and disposed. Very often we would end up with broken bags and sludge stuck to the bottom (regardless that the process temperature was approximately 260°F and bags were rated for 400°F). After evaluating the problem we concluded that breakage of bags occurred for two reasons:

a) the trapped air between a bag and the chamber would heat to over 400°F;and,

b) during the cooling down the bag would stick to the bottom and break when removed.

The problem has been solved by filling a space between the bag and the chamber with thermal oil (with a boiling temperature much

higher than the boiling temperature of paint thinner), which provided better heat distribution, eliminated potential air pockets and prevented bags from sticking to the still. The thermal oil stays permanently in the still. A bag is inserted into the unit and when contaminated paint thinner is pumped into the bag, the level of the thermal oil rises, filling out the space between the bag and the still.

Recovery rate is a minimum of 85%, so the amount of the purchased paint thinner has been reduced to 1,300 litres per year. Generated waste has also been reduced by 85% to 1,300 - 1,500 litres per year.

3.3.3 Recycling of Varsol

Varsol is used to wash the cutting oil from the purchased parts prior to further dry machining and packing.

All our attempts to recycle contaminated varsol have failed. The recycled varsol was not coming out clean enough for reuse. A sulphur-type odour would also accompany the recycling process, thus creating lots of complaints from the workers.

Finally, we discovered that the varsol and cutting oils created an azeotrope (a mixture for which the vapour from the liquid has the same composition as the liquid itself). Therefore, we were not able to use our distillation unit to recover the varsol.

An alternative solution has been found to the existing replacement/disposal practice. We have signed a contract with "Safety-Kleen Canada Inc." to service our operation. The service includes removal of contaminated varsol, cleaning the washing machine and filling the machine with clean recycled varsol. The contaminated varsol is then recycled by "Safety-Kleen" for future reuse.

Prior to the project, the yearly usage of varsol was approximately 7,000 litres, with similar amount of generated waste. Implementation of the service contract has allowed us to eliminate purchasing the replacement varsol. There is no waste varsol generation.

4.0 RESULTS AND CONCLUSIONS

Main objectives for Mueller Canada were:

a) to reduce amount of the hazardous waste generation

b) to reduce amount of the chemicals purchased

c) to reduce the cost associated with purchasing replacement chemicals and disposing of waste.

After implementation of the project, all objectives have been met. The amount of replacement chemicals has been reduced by between 40 to 90%. Waste generation has been reduced by up to 90%. Additional benefits are: increased tool life, improved quality of the product, reduced requirements for some additional chemicals.

The equipment, purchased for recycling, in many instances worked to our expectations. Although, some changes had to be made to achieve better results.

The water filtration unit required waste water to be prefiltered prior to processing. We had to add an additional holding tank and introduce a fluid equalizing system. Also, the unit has had some mechanical problems which have been corrected by replacing defective components.

The solvent distillation unit did not provide us with a safe means of removing the paint thinner sludge. We had to spend a lot of time trying to solve the problem until we came up with an idea to use thermal oil as a "jacket". Also the unit has not been able to recycle contaminated varsol.

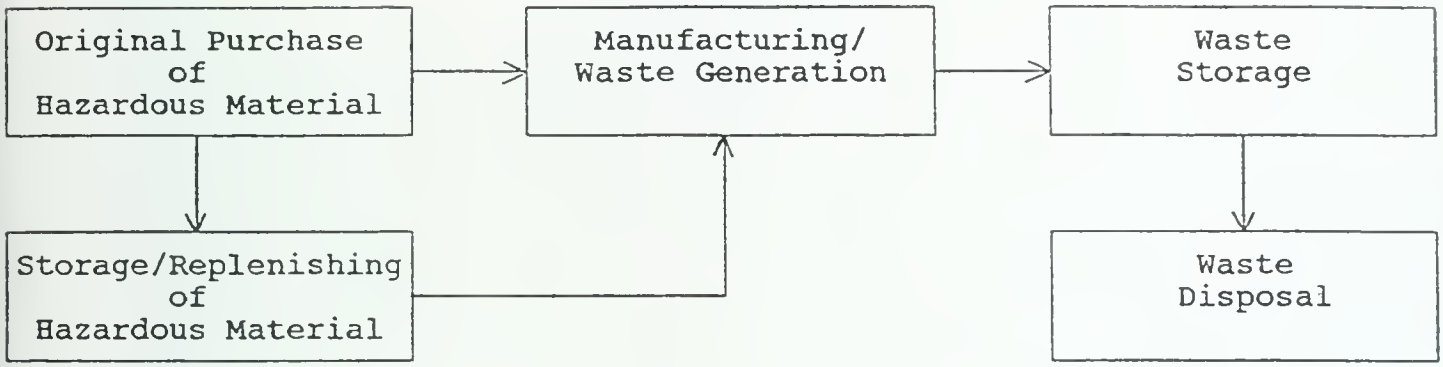
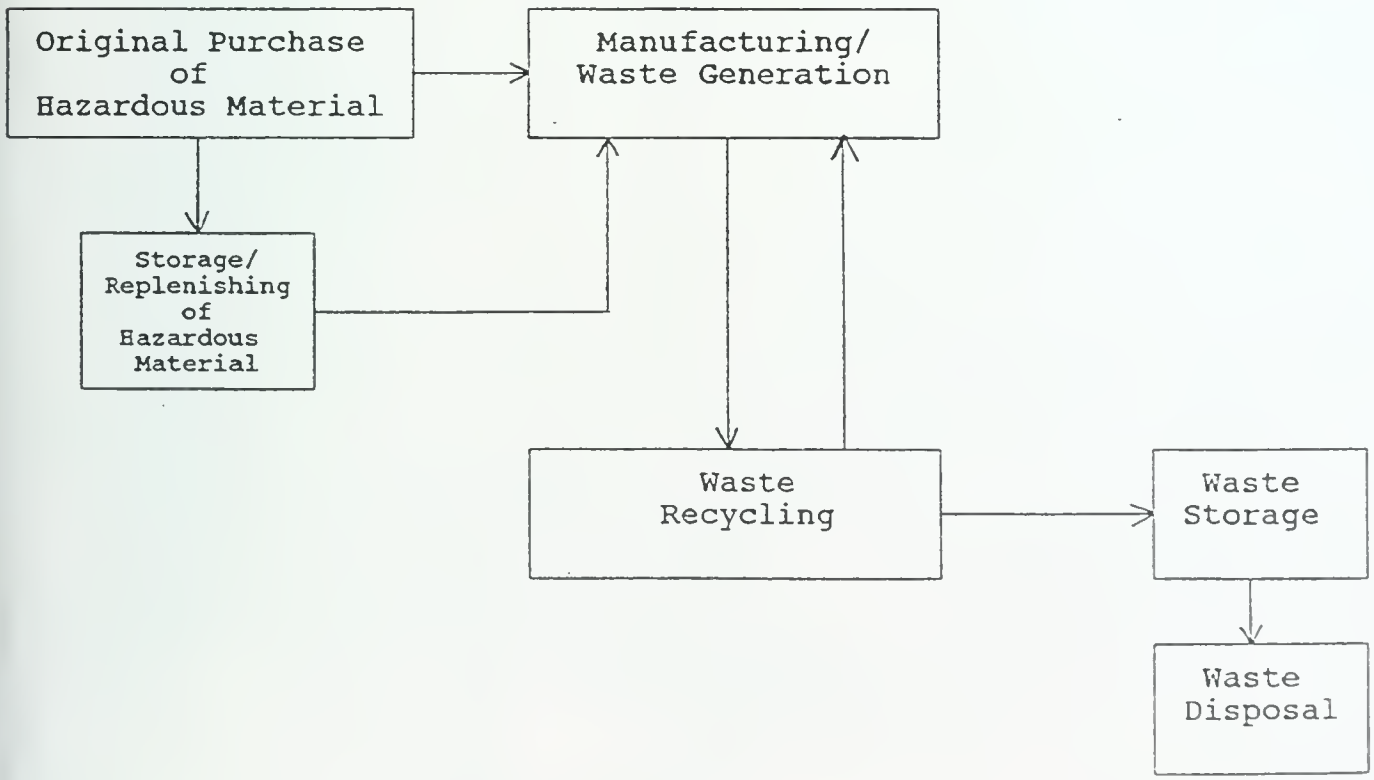
In the future, more attention should be given to all the details of the project. The potential equipment suppliers should be supplied with a sufficient amount of contaminated waste, so the proper tests and analysis could be conducted. Then all the evaluations and recommendations should be provided to the buyers prior to the start of the project.

overall, the project has been a success for Mueller Canada. Estimated savings from reduction in replacement and disposal costs -- approximately $50,000.00 per year. Total waste generation has been reduced from approximately 39,000 litres to 6,000 litres per year, with 33,000 litres of waste per year diverted from disposal.

ADDENDUM "A"

WASTE GENERATION PROCESS DIAGRAM

Old Method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